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Pharmacological potential of cactus pear (*Opuntia ficus Indica*): A review

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Abstract

Plants with strong bioactive constituents have recently gained much interest for improving overall well being as well as for prevention and treatment of various diseases. The presence of potentially active constituents in cactus pear and their multifunctional action, make cactus pear (*Opuntia ficus Indica*) ideal candidate for the production of health-promoting foods and pharmacologicals. Despite the appreciation by its pharmacological property in different counties, cactus pear is still scarcely used in modern nutrition and medicine. However, recent studies on cactus pear revealed that the different parts of the plant to be potential candidates for the development of healthy foods and pharmaceuticals. Hence, this review is intended to summarize recent developments of the use of cactus for diverse pharmacological importance.

Keywords: pharmacological, cactus, *Opuntia ficus Indica*, bioactive constituents

Introduction

Plants with strong constituents have recently gained much interest for improving overall well being as well as for prevention and treatment of various diseases. It is generally believed that the beneficial effect of herbal remedies can be obtained from active constituents present in the whole plant, parts of the plant (flowers, fruits, roots or leaves), or plant materials or combination thereof (Ahn, 1998; De Smet, 2002) ^[1, 6]. Cactus (*Opuntia ficus indica*) commonly known as prickly pear belongs to the family Cactaceae. Family Cactaceae is reported to have 130 genera and nearly 1500 species, which were originally native to the new world. Being so water-use efficient, they are highly useful in arid and semi arid environments (Griffith, 2004; Pareek *et al.* 2003) ^[13, 24].

Cactus produces sweet, nutritionally rich edible fruits; its tender cladodes are used as fresh green vegetable and salad (Griffith, 2004) ^[13]. Cactus is used in nutrition, health, cosmetics and others. The fruit as well as cactus stem are used to prepare value added products such as jam, wine, body lotions, shampoo and creams (Pareek *et al.* 2003) ^[24]. It also has been traditionally used in folk medicine in several counties for several medicinal purposes because of its role in treating a number of diseases and conditions, anti-inflammatory effects (Hunt *et al.* 2006; Salim *et al.* 2009) ^[15, 26], hypoglycemic effects (Paiz *et al.* 2010; Schaffer *et al.* 2005) ^[22, 27], antimicrobial activity (Ennouri *et al.* 2014; Yasmeen *et al.* 2012) ^[8, 31], anticancer effect (Zou *et al.* 2001) ^[32], inhibition of stomach ulceration (Kunti, 2004) ^[17], antioxidant effects (Galati *et al.* 2003; Kunti, 2004; Zou *et al.* 2001) ^[9, 17, 32], and neuroprotective effects (Dok-Go *et al.* 2003) ^[7].

Recent scientific studies have demonstrated the presence of potential phytochemicals in cactus or in its different parts, which may have high potential interest in human health and medicine (Almimi *et al.* 2010; Valente *et al.* 2010) ^[3, 29]. As a general rule in herbal medicine, the extraction of phytochemicals from plant materials using solvents represents a key step in the manufacturing of phytochemical rich products. Researchers have focused their investigation on cactus to find out the properties of the plant that could be the basis to use in the prevention and treatment different diseases (Harnandaz *et al.* 2011) ^[14]. Moreover, recent studies on cactus revealed that the different parts of the plant to be potential candidates for the development of healthy foods and pharmaceuticals. Therefore, this review is intended to summarize recent developments on the pharmacological importance of cactus.

Origin and distribution of *Opuntia ficus Indica*

Opuntia spp. Originated in the tropical and subtropical Americas and the plant have spread further into other continents - carried by peoples. Cactus pear (*Opuntia ficus indica*) is a suitable plant for water scarcity regions. It is a succulent, xerophytic, spiny or spineless plant of multiple purposes (Griffith, 2004) ^[13]. The plant has different parts, which includes flower,

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seed, cladodes, skin fruit and pulp.

Botanic description

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Caryophyllales
Family : Cactaceae

Traditional Uses

Cactus pear (*Opuntia ficus indica*) used as a folk medicine in different counties for the treatment of burns, wounds edema and indigestion. As report of different studies, it has been revealed that its alcoholic extracts possess anti-inflammatory, hypoglycemic, antibacterial activities. Moreover, the prickly pear cactus stem have been used traditionally to treat diabetics (Saenz, 2000) [25].

Phytochemical composition of cactus

The cladodes and skin fruit of cactus have found to be potential source of useful phytochemicals like ascorbic acids, vitamins, carotenoids, fibers, amino acids, antioxidant compounds (flavonoids, betaxanthin, betacyanin, and alkanoids) (Ennouri *et al.* 2014; Yasmeen *et al.* 2012) [8, 31]. Also, cactus flowers contains different flavonoids notably kaempferol and quercetin (Kunti, 2004; Moussa *et al.* 2011) [17, 20].

Pharmacologic activities

Opuntia ficus Indica have been used by humans for many years. Besides being consumed as food or beverages, most portions of *Opuntia ficus indica* have been used as medicine and in recent times have also been prepared as juice, jam, frozen fruit and spray dried powder (Salim *et al.* 2009) [26]. According to different studies, the *Opuntia ficus Indica* have different pharmacological activities and presented in summarized form in Table 1.

Anti-inflammatory activity

Many studies have reported that the analgesic and anti-inflammatory actions of *Opuntia* by using either fruit extract, lyophilized cladodes, or the phytosterols from fruit and stem extracts (Allegra *et al.* 2014; Kemi *et al.* 2006; Panico *et al.* 2007; Tesoriere *et al.* 2014) [2, 16, 23, 28]. Moreover, *Opuntia ficus indica* has been reported to have anti-inflammatory activity due to B-sitosterol extract from the stem of cactus (Allegra *et al.* 2014) [2]. This the first evidence on the anti-

inflammatory activity of B-Sitosterol lyophilized aqueous extract of the fruit of *Opuntia ficus indica*.

Anti-ulcer activity

In Sicily folk medicine, *Opuntia ficus indica* cladodes are used for treatment of gastric ulcer and its cicatrissant action. The effect of lyophilized cladodes on ethanol induced ulcer in rat was investigated and the ultra-structural changes were observed by TEM, confirming the protective effect exercised by administration of lyophilized cladodes. The reason might be the mucilage of *Opuntia ficus indica* was the principal compound for antiulcer action (Galati *et al.* 2003) [9].

Antioxidant activity

The ethanol extract of stem of *Opuntia ficus indica* was assessed to determine the mechanism of its antioxidant property. The ethanol extract revealed a concentration dependent inhibition of linoleic acid oxidation in the thiocyanate assay system. Moreover, the extract showed dose-dependent free radical scavenging activity. Hence, the ethanol extract was found to be potential in protecting plasmid DNA against the strand breakage induced by hydroxyl radicals. The ethanol extract was determined as containing a high amount of phenolic compounds responsible for antioxidant activity of the extract (Butera *et al.* 2002; Gentile *et al.* 2004) [4, 12].

Antibacterial activity

According to recent study (Gebrekidan and Aragaw, 2017) [11], the antibacterial activity of methanol, ethanol, chloroform extracts of cladodes and skin fruit extracts of *Opuntia ficus indica* have demonstrated great antibacterial activity against both gram positive and gram negative bacteria. The antibacterial activity might be due the presence of various bioactive constituents in the extracts.

Antiviral activity

Study conducted by Gentile *et al.* (2004) [12] demonstrated that the administration of a cactus stems extract (*Opuntia ficus indica*) to mice, horse, and humans' inhibits intracellular replication of a number of DNA and RNA viruses.

Antidiabetic activity

The prickly pear cactus stems have been used traditionally to treat diabetes in Mexico (Almimi *et al.* 2010) [3]. In recent times, *Opuntia* spp. are among the main of products recommended by Italian herbalists, which may be effective in reducing glycemia (Morales *et al.* 2012) [19].

Table 1: Main Biological Effects of Cactus Preparations

Biological activity	Source of Cactus Products	References
Antimicrobial	Methanol extract of cladodes and skin fruit	(Gebrekidan and Aragaw, 2017) [11]
	Ethanol extracts of cladodes and skin fruit	(Gebrekidan and Aragaw, 2017) [11]
	Chloroform extracts of cladodes and skin fruit	(Gebrekidan and Aragaw, 2017) [11]
	Hexane extracts of cladodes	(Ennouri <i>et al.</i> 2014) [8]
	Aqueous alcoholic extracts of cladodes Cactus stem extract	(Ennouri <i>et al.</i> 2014; Yasmeen <i>et al.</i> 2012) [8, 31]
Anti-inflammatory and antioxidant	Butanol and methanol extract of fruit	(Allegra <i>et al.</i> 2014; Kemi <i>et al.</i> 2006; Panico <i>et al.</i> 2007; Tesoriere <i>et al.</i> 2014) [2, 16, 23, 28]
Hypolipidemic and Hypocholesterolemic	Cladodes powder	(Dok-Go <i>et al.</i> 2003) [7]
	Cladodes (Glycoprotein)	Yasmeen <i>et al.</i> 2012) [31]
	Seed powder and oils	(Morales <i>et al.</i> 2012) [19]
Antidiabetic	Capsule: cladodes and skin fruit extract	(Morales <i>et al.</i> 2012) [19]
	Cactus powder in capsule	(Almimi <i>et al.</i> 2010) [3]
	Aqueous extract of skin fruit and cladodes and mixture cladodes and skin fruit extracts Capsule	(Butterweck <i>et al.</i> 2011; Van <i>et al.</i> 2012) [5, 30]
Hypoglycemic	Polysaccharide extracts from cladodes	(Paiz <i>et al.</i> 2010) [22]
	Extract powder racket after drying	(Schaffer <i>et al.</i> 2005) [27]

Anti-inflammatory	Indicaxanthin from fruit	(Tesoriere <i>et al.</i> 2014) [28]
	Lipophilized extracts of cladodes	(Panico <i>et al.</i> 2007) [23]
	Indicaxanthin from cactus pear fruit	(Kemi <i>et al.</i> 2006) [16]
	Methanol extracts of cactus stem and Methanol extracts of prickly pear fruit	(Allegra <i>et al.</i> 2014) [2]
Antioxidant	Betalain a pigment purified from fresh pulp of cactus pear	(Gentile <i>et al.</i> 2004) [12].
	Betanin prickly pear fruit extracts	(Butera <i>et al.</i> 2002) [14]
	Ethanol extract of stem	(Lee <i>et al.</i> 2002) [18]
	Cactus pear fruit	(Oh <i>et al.</i> 2006) [21]
	Flavonoids fraction from of juice of whole fruits	(Dok-Go <i>et al.</i> 2003) [7]
	Glycoprotein isolated from <i>Opuntia ficus indica</i> var. sabotenmakino	(Paiz <i>et al.</i> 2010) [22]
Anticancer	Cactus pear fruit extract	(Galati <i>et al.</i> 2002) [10]
Hepatoprotective	Cladodes extract	(Dok-Go <i>et al.</i> 2003) [7]
Neuroprotective	Methanol extract of skin fruit	(Dok-Go <i>et al.</i> 2003) [7]
Antiulcer	Lyophilized cladodes Pectin polysaccharides cladodes	(Galati <i>et al.</i> 2003) [9]

Conclusion

The review literature revealed the presence of many bioactive constituents in cactus (*Opuntia ficus Indica*), which could be responsible for various nutritional, medicinal and pharmacological uses of cactus (*Opuntia ficus Indica*). Beside the phytochemicals present in cactus different parts, this review has also devoted a great attempt to demonstrate the biological activities of the different parts of cactus. Further studies need to be carried out on cactus (*Opuntia ficus Indica*) in order to confirm its medicinal uses and also explore other potential pharmacological activities. This plant could serve as source of bioactive constituents for future pharmacological studies and drug development.

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